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ABSTRACT

Reviewed is the research on the early prediction of academic underachievement or learning difficulty and described are predictive projects currently underway by the author. Suggested by the review are that the child at highest risk for school learning difficulties is a later-born male, who has a history of pre or perinatal complications and who is not of superior intelligence. Concluded from examination of different types of predictive measures at school entry are that group tests, and, in particular, readiness tests, are superior to most individually-administered tests as predictors; that single subtests (e.g. letter naming) often surpass total tests in predictive validity; and that kindergarten teachers' judgements tend to be more accurate than many formal tests. Preliminary findings of the author's research are reported to show that the Wechsler Preschool and Primary Scale of Intelligence information and sentences subtests, letter naming, name writing, and ability to name five basic geometric shapes are excellent predictors of early academic achievement. (Author/DB)

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EARLY PREDICTION OF ACADEMIC UNDERACHIEVEMENT

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Summary

In this review of research on the early prediction of academic underachievement studies of prognostic signs in infancy and studies of identification at school entry are discussed. Predictive projects currently being carried out in Holbrook, Ma., by the author and her colleagues are also described.The main general findings of the infancy research suggest that the child at highest risk for school learning difficulties is a later-born male, who has a history of pre- or peri-natal complications and who is not of superior intelligence. General conclusions from examination of different types of predictive measures at school entry were that group tests, and, in particular, readiness tests, are superior to most individually-administered tests as predictors, that single subtests (e.g. letter naming) often surpass total tests in predictive validity, and that kindergarten teachers' judgements tend to be more accurate than many formal tests.Preliminary findings in Holbrook, Ma., indicate that the WPPSI Information and Sentences subtests, letter naming, name writing, and ability to name five basic geometric shapes are excellent predictors of early academic achievement.

EARLY PREDICTION OF ACADEMIC UNDERACHIEVEMENT

During the past 40 years or so hundreds of research projects have been carried out for the purpose of detecting potential learning problems in young children. The majority of these studies have focused on the child at school entry, for the practical reason that it is not easy to obtain unbiased samples of children before they enter the schools. There is also, however, a sizable number of research studies which have attempted to predict later learning and behavior disorders from prognostic signs in infancy.

The impetus behind this vast amount of research is the conviction that early identification of children likely to have learning problems will lead to early intervention, and that special teaching techniques and intensive help may overcome the problems. One of the leaders in the early predictive research, de Hirsch (de Hirsch et al.,1966), has stated that long experience with older educationally disabled children convinced her that many of them would not have required help if their difficulties had been recognized at an early age.

On the other hand, some writers have expressed considerable doubts with regard to the usefulness of early identification (Alberman,1973; Keogh & Becker,1973; Schaer & Crump,1976). For example, Alberman questions the gains to be had from early diagnosis of learning disabilities and suggests that there is not enough evidence that early schooling will improve prognosis. Schaer and Crump also stress that little is known of the actual benefits

of early identification and the resulting remediation activities. Unfortunately, although early identification studies have been numerous, follow-up studies of the advantages to be gained from such identification have been very sparse. Schaer and Crump may, therefore, be justified in stating that a great deal of time, money, and effort are spent "aimlessly and without adequate justification" each year on screening.

There does, however, appear to be compelling evidence that intensive early intervention programs with young children, who are handicapped or deprived, can be most effective. One immediately thinks of the classic work of Skeels and Skodak (Skeels, 1966) in the 1930s. The 13 low-IQ children who were placed individually under the care of mentally retarded girls and women in state hospital wards at an average age of 19 months improved so much as a result of the stimulation they received, that they were able to be adopted at 3 to 4 years of age. A control group of 12 children who remained in the original institution deteriorated rapidly during the same period of time. Follow-up in adulthood revealed that all 13 of the experimental group were normal in intelligence, self-supporting and competent, compared with only one of the control group.

Other more recent examples of early childhood programs which have had objectively substantiated success are the Preschool Program for Down's Syndrome Children at the University of Washington Preschool Center (Hayden and Dmitriev,1975), and the Milwaukee Project (Heber and Garber,1975) which was an intervention program designed to prevent cultural-familial

mental retardation.

Since there is evidence that special remedial programs with severely handicapped and deprived children can have striking success, one is led to believe that well-designed long-term programs for children with lesser handicaps could be no less effective, and that the attempts to identify children with potential learning problems at an early age are justifiable. There is, however, a great need for careful documentation of the success of remedial programs designed to help young children identified as "high-risk" in the early years of life.

The aim of this paper is to review as many different types of early identification studies as possible and to try to determine which prognostic indicators appear to have highest validity. At the same time it is essential to heed the warnings of such writers as Schaer and Crump (1976) and to consider the most economical type of identification techniques in terms of time, effort and money.

In the title of this paper the term "academic underachievement" is used, rather than such a term as learning problems or learning disabilities. Academic underachievement not only implies objective measurement of achievement, but also is intended to encompass a somewhat broader population than is usually implied in the term "learning disabilities", with its exclusion of the slow-learning, culturally deprived and emotionally disturbed child. Early screening is likely to pick up children who will perform poorly in school for a variety of reasons, and not all such children will fit the usual definition of learning disability

(Clements,1966; Myklebust,1968). On the other hand, this paper is not concerned with the child who is so severely handicapped that he is fairly easily identified as mentally retarded, autistic, deaf, blind, cerebral palsied etc. in the first 2 or 3 years of life.

Prognostic Signs in Infancy

Among the originators of the concept that development in infancy is closely related to childhood status were Gesell and Amatruda, who 35 years ago proposed the term "minimal cerebral impairment" long before the phrase "minimal brain dysfunction" became popular (Gesell and Amatruda, in Knobloch and Pasamanick,1974). Their successors, Knobloch and Pasamanick, extended this idea to the concept of a "continuum of reproductive casualty", in which severe abnormalities of the pre- and peri-natal period are associated with neonatal mortality and with severe manifestations of brain damage, while lesser abnormalities are associated with a variety of milder impairments, including reading disability and hyperactivity (Pasamanick & Knobloch,1960).

The studies of prognostic signs in infancy, which may be correlated with learning and behavior problems in the school years, can be divided into prospective and retrospective studies. In the prospective studies a group of children is followed for several years starting with the mothers' prenatal checkups. Complete pre- and peri-natal data, family and developmental history are usually available for each child. In the retrospective studies the history of children with school learning or behavioral

problems is traced back to birth and pregnancy, and compared with that of controls. Unless the early history can be documented through hospital or pediatricians' records, there are bound to be some inaccuracies in retrospective studies.

An example of a comprehensive prospective study is the National Child Development Study (Alberman,1973; Davie, Butler and Goldstein,1972) in which a complete cohort of children born in England during a period of one week has been followed up. It was found that an abnormal condition of the child in the neonatal period, regardless of its cause, was the most efficient single predictor of handicaps. The factors most closely associated with learning disabilities were SES and cultural background, and position in the family. At age 7 years the difference in reading age between the highest and lowest social classes was 17 months, and the difference between first and fourth or later-born children was nearly 16 months. An increase of 1000 grams in birthweight, other factors being equal, made a difference of about 4 months in reading age.

In a Brown University, Rhode Island, study 380 children were followed to 7 years (Denhoff, Hainsworth and Hainsworth,1972). The aim was to develop a "Provisional Outcome Index" to identify during their first year children at risk for later development of learning problems. There were no significant correlations between birth stress and the 7 year outcome, as measured by WISC IQ, WRAT achievement and performance on the Meeting Street School Screening Test (MSSST). Neonatal condition and the first year Outcome Index were, however, significantly

related to these measures. The greatest proportion of suspicious cases stemmed from the hypo- and hyper-reactive newborn categories, with lethargy, abnormal cry, jitteriness or tremulousness and hyperactive behavior predominating. A Brown University researcher (Rosenblith, reported in Denhoff et al., 1972) found that a discrepancy in muscle tension between extremities, with upper limb flaccidity and lower limb hypertonicity, is an unfavorable prognostic sign, as also is oversensitivity to light.

A Mayo Clinic prospective study of 386 neurologically normal children to age 7 years (Colligan,1974) found that the concept of a continuum of reproductive casualty was only marginally supported. However, Knobloch and Pasamanick (1974) have shown that there is a significant direct relationship between infant neuromotor status and adequate performance on a battery of tests at school age. Fewer children whose IQ scores were 96 or higher, but who had demonstrated neuromotor abnormalities as infants, had average or better performance at school age on several standardized measures of achievement, language, visual motor, gross motor ability etc., than did children who were normal in infancy.

The main findings of a longitudinal prospective study of 1000 infants (Jordan, 1971) at age 3 years were that multiple perinatal abnormalities exert a negative influence on growth and that the critical period when environmental factors become influential seems to be between 24 and 30 months.

A follow-up of anoxic infants at age 3 years revealed

that the children showed significantly poorer performance on all cognitive tasks than did the children in two comparison groups (Graham et al., 1962). Another researcher (Klatskin,1964) reported that the effects of adverse perinatal experiances were more clearcut among average than superior children, with recovery of function with increasing age being greater in children of superior intelligence. Whereas there was a difference in verbal function between the unstressed and the presumed stressed groups at age 3 years, this was no longer observed by 5 years. However, the presumed stressed children continued to be significantly impaired in integrative skills, such as perception of a complex visual stimulus or making a complex visuomotor response.

An important finding in some of the retrospective studies of children with learning problems is that no one single abnormality in the pre- or peri-natal period is associated with later problems. Rather, there is an association with a constellation of such abnormalities (Galante et al., 1972; Hoffman, 1971).

Hoffman attempted to develop a Learning Problem Indication Index based on perinatal and early developmental abnormalities. The perinatal factors included in the Index were prematurity, prolonged labor, difficult delivery, cyanosis, blood incompatibility, and adoption; the developmental factors were late or abnormal creeping, late walking, prolonged tip-toe walking, late or abnormal speech, and ambidexterity after 7 years. This Index

can be scored and Hoffman suggests a possible interpretation of scores. In a study using Hoffman's Learning Problem Index 8 of 10 children with learning disabilities proved to have a history of perinatal or developmental abnormalities, as measured by the Index (Wilborn and Smith, 1974).

Galante and his colleagues (Galante et al., 1972), who followed a group of 114 children for 7 years from kindergarten entry through grade 6, found an unusual birth history in 57 percent of underachievers compared with 14 percent of children achieving above expectation. Galante, like Klatskin, found that superior intelligence was a compensatory factor. A child with a combination of most of the following characteristics was almost certain to become a severe underachiever by grade 6, according to Galante : male sex, not first-born, unusual birth history, eye muscle imbalance, poor in perception of spatial relationships (SRA Primary Mental Abilities subtest) and on the Draw-a-Person test at kindergarten, mixed dominance at 8 years, inadequate home environment, and reading below expectancy by his second year at school.

Some years ago there was a study of approximately 2000 children in the Baltimore Public Schools (Rogers et al., 1955). These were children with behavior problems (which included inadequate school work) and a control group. The problem cases had a significantly larger proportion of premature births and abnormalities of the pre- and peri-natal periods, especially bleeding and toxemias of pregnancy. It was found that abnormal conditions of the children at birth (asphyxia, cyanosis, convulsions etc.) did not differ in occurrence among cases and

controls, unless accompanied by prematurity or preceding maternal complications in pregnancy. This finding differs from the findings of various other studies that the condition of the child in the neonatal period is a crucial factor. The Baltimore study does, however, lend support to the hypothesis that it is a combination of pre- or peri-natal problems that is associated with later school problems, rather than a single factor.

In retrospective studies based on smaller numbers of subjects findings are variable. Lievens (1974) reported that among his clinical child patients with learning and behavior problems, who came from good homes, the only past pathological element was a difficult birth. Hunter and Johnson (1971) found no difference between 20 readers and 20 nonreaders, all male, in perinatal or developmental factors, except that the nonreaders crawled at a significantly earlier age, fewer of the nonreaders were first-born (only one), and at age 9 years significantly more of the nonreaders tested left-handed on various laterality tests, although all of them were right-handed. Thus, this study concurs with that of Galante in finding that being a later-born male is one of the factors which may be associated with school learning problems.

A somewhat different approach to prediction of later school problems in preschool children is through a count of the number of minor physical anomalies present. Several studies have been carried out as part of a longitudinal research program of the

Child Research Branch of the National Institute of Mental Health (Waldrop and Halverson, 1971). Waldrop and Halverson based their list of anomalies on that used by Goldfarb and Botstein to differentiate schizophrenic children from normals. So-called "normal" boys with a high incidence of minor physical anomalies are apt to be the frenetic, intractable children in a nursery school setting and the hyperactive, troublesome children in an elementary school. Waldrop and Halverson hypothesize that it was probably the same factors operating in the first weeks of pregnancy that influenced the occurrence of both the morphological aberrations and the predisposition for impulsive, hyperactive behavior. These authors list 18 minor physical anomalies affecting the head, eye, ears, mouth, hands, and toes. Included in the list are fine electric hair, abnormal head circumference, epicanthus and hypertelorism, low-seated, malformed or asymmetrical ears, high-steepled palate, incurved fifth finger, single transverse palmar crease, third toe longer than second, and partial syndactylia of the two middle toes.

In an elementary school it was found that the more hyperactive a boy was, the more minor physical anomalies he was likely to have. Three-quarters of the boys in an Easter Seal nursery school program for children with speech and hearing deficits were found to have curved fifth fingers, high-steepled palates, and partial syndactylia of the second and third toes.

In a similar study another group of researchers (Rosenberg and Weller, 1973) found there to be a significant relationship

between academic failure in a group of 99 first grade children and the presence of minor physical anomalies. Not one of the 26 children with stigmata scores of 0 to 1 had to repeat; 9 Of 15 repeaters had scores of 5 or more.

Waldrop and Halverson are careful to point out that it is the child with multiple minor physical anomalies who is likely to be hyperactive. They found very few boys with high scores who were not hyperactive, but there were some hyperactive boys with low anomaly scores, indicating that hyperactivity may be the effect of experiential as well as congenital factors. The relationship between minor physical anomalies and difficult behavior was not as clearcut for girls as for boys, suggesting that males are more vulnerable to genetic and prenatal stresses.

Although many of the findings in the infancy studies are contradictory, there appears to be a consensus that a later-born male, who has a history of pre- or peri-natal difficulties and who is not of superior intelligence, is a child at high risk for school learning difficulties. If he is also a boy with several minor physical anomalies, the risk of hyperactive and difficult behavior, and school failure, is very high.

Identification at School Entry

Predictive studies on 3-to-4-year-old children are very sparse. The overwhelming majority of studies which attempt to predict underachievement are based on tests given in kindergarten or beginning first grade and most of them follow up the children no further than the end of first grade or the beginning of second. The most widely used form of predictive test in this country is the reading readiness test (Farr and Anastasiow,1969). In a recent survey of 581 school districts it was found that 55 percent do screening for academic readiness, with the Metropolitan Readiness Test being the most frequently used single measure (Maitland et al., 1974).

The term "readiness" implies maturational immaturity as an etiological concept, but many researchers have stressed the heterogeneity of the population identified as having possible learning disabilities. For example, in a survey of over 1200 children in 48 kindergarten classes (Haring and Ridgway,1967) it was emphasized that the children identified as having potential learning disabilities revealed few common learning patterns. The conclusion drawn from a screening of more than 2000 kindergarten children was that lack of readiness or potential learning disabilities may result from intellectual, environmental, or maturational factors (Banks, 1970). Hagin and her colleagues (Hagin et al., 1971) subdivided their high-risk group into children with specific language disability, organics, and the developmentally immature. There is evidence from another study

that children categorized as immature at kindergarten age may do better in the later school years than the organic or minimal brain dysfunction children, although worse than so-called "normal" children (Eaves et al.,1974).

In its review of the kindergarten and first grade studies this paper will compare the predictive power of various types of measures : Group versus individually-administered tests;
Experimental batteries versus standardized tests;
Single variables versus multifactor batteries;
Teacher judgement versus formal tests.

Group versus Individually-Administered Tests

If the predictive power of a group test is equal, or nearly equal, to that of an individual test battery, the group test will be preferable for screening purposes because of the greater ease and lower cost of administration. The group tests most frequently used, other than readiness tests, are intelligence tests.

When the correlations of the Metropolitan Readiness Test (MRT) with later reading achievement are examined, the median correlation for 37 studies (including 16 correlations given in the MRT manual) is .58, with a range of .22 to .78. Numbers of subjects range from 25 to nearly 10,000. In more than two-thirds of the studies the correlation with reading is at least .50.(See Table 1a.) For 11 studies in which the Lee-Clark Reading Readiness Test was the predictor the median correlation was .57, with a range of .43 to .74, and with numbers of subjects ranging from 44 to 703. (See Table 1b.) Other readiness tests appear to give similar results. For example, the range of predictive validity

given in the Clymer-Barrett Prereading Battery manual is .40 to .69 for the relationship between the total test and reading comprehension subtests (Clymer and Barrett,1968). Dykstra (1967) reported that correlations between readiness tests and reading usually fall between .40 and .60.

Twenty-two studies were found in which a group intelligence test administered in kindergarten or beginning first grade was used to predict grade 1 or 2 reading achievement. The tests included the Lorge-Thorndike (6 studies), the Detroit First-Grade Intelligence Test (6), the California Test of Mental Maturity (2), the Otis Quick Scoring (4), the Pintner-Cunningham (2), and the Kuhlmann-Anderson (1) and Kuhlmann-Finch (1). The median correlation for the Lorge-Thorndike is .445 (range .10 to .57), for the Detroit .46 (range .39 to .57), and .45 for the other ten combined (range .32 to .73). (See Table 2.) Dykstra (1967) quotes five studies in which the correlations between the Pintner-Cunningham and reading achievement were .43 to .75.

Another group test sometimes used for predictive purposes is the Frostig Developmental Test of Visual Perception. Eight correlations with reading subtests in five studies range from .06 to .62, with a median value of .425 (Benger,1968; Bryan,1964; Colarusso et al.,1975; Mlodnosky,1972; Serwer et al.,1972).

Individually-administered predictive tests reported for kindergarten or first grade children include the WISC or WPPSI, the Stanford-Binet, the Peabody Picture Vocabulary Test (PPVT), the Illinois Test of Psycholinguistic Abilities (ITPA), and the Meeting Street School Screening Test (MSSST). More of these

studies involve long-term followup, with the criterion achievement tests given in grades 3 - 5.

For the WISC (9 correlations) and WPPSI (2) the range of correlations with achievement is from .20 to .57, with a median value of .39 (Ames and Walker,1964; Dudek et al.,1969b ; Duffy et al.,1972; Egeland et al.,1970; Feshbach et al.,1974; Henderson,1969). The highest correlation was obtained at grade 5 (Ames and Walker,1964). For the Stanford-Binet the range is from .31 to .62 (5 correlations) with a median of .53 (Benger,1968; Dean,1939; de Hirsch et al.,1966; Hirshoren,1969; Morphett and Washburne,1931). For the PPVT the range is .16 to .62 (4 correlations), with a median value of .345 (Benger,1968; Lessler and Bridges,1973; Panther,1967; Tauber,1967). For the ITPA the range is .13 to .43 (7 correlations) with a median of .32 (Duffy et al.,1972; Egeland et al.,1970; Hirshoren,1969; Serwer et al.,1972). For the MSSST the range is .53 to .82 (4 correlations) with a median of .64 (Denhoff et al.,1968; Kapelis,1975).

One study reports that the kindergarten Rorschach correlated .53 with fifth grade reading (Ames and Walker,1964), and the Lincoln-Oseretsky Tests of Motor Proficiency correlated .50 with first grade and .43 with second grade achievement (Dudek et al.,1969b).

Although the range of correlation coefficients is large for most types of tests, a close scrutiny suggests that, on average, the group-administered readiness tests are better predictors of end-of-first-grade reading achievement than the group intelligence

tests or than most of the individually-administered tests. The Frostig composite score appears to be particularly variable as a predictor. Waugh and Watson (1970) concluded from a review of the relevant research that visual perceptual tests have little predictive power above grade one.

Of 8 studies in which the predictive validity of readiness tests was directly compared with that of intelligence tests, 6 demonstrated that the readiness test used was more predictive than the group or individual intelligence test (Egeland et al., 1970; Gav 1958; Hopkins and Sitkei, 1969; Lee et al., 1934; Panther, 1967; Pratt, 1949). Two studies indicated the reverse (Dean, 1939; Giebink and Birch, 1970). Egeland reported that even by grade 3 the readiness tests continued to contribute to the predictive correlation (Egeland et al., 1970).

Experimental Batteries versus Standardized Tests

There has been a long line of researchers dating back at least to Monroe (1935), whose aim has been to find the best possible combinations of variables for prediction. Among the better known of these researchers are de Hirsch and her co-workers (de Hirsch et al., 1966; Jansky and de Hirsch, 1972). In their preliminary work based on a sample of 53 children a Predictive Index of 10 items was selected. The Index included Pencil Use, the Bender Gestalt Test, the Wepman Test of Auditory Discrimination, and the Gates Word Matching Test. The disadvantages of the Index for widespread screening are its length and the necessity for individual administration of some of the items. The Final Screening Index, based on 355 children (Jansky and de Hirsch, 1972), consists

of only 5 short subtests, which correlated .66 with second grade reading. The main contributors to the predictive power of the Index are Letter Naming and a new Picture Naming test.

Several promising earlier batteries of predictive tests have seldom been used in toto by subsequent researchers, probably because of their length, although isolated subtests have been used. An example of such a battery is that of Monroe (1935), which included auditory, visual, language, speech, motor, and intelligence tests, and correlated .75 with reading (N = 85), and another is Goins' (1958) battery of 14 visual perceptual tests, which correlated .497 with reading (N = 120).

At least two recent researchers have built a predictive battery on Piagetian tasks (Dudek et al., 1969a; Kaufman and Kaufman, 1972). Although the contents of these two batteries are very different, they were almost equal in predicting first grade achievement : Dudek, r = .63, N = 100; Kaufman, r = .64, N = 80. These Piagetian tasks do, however, require individual administration. A combination of the Piagetian Seriation and Time subtests, the WISC Picture Arrangement, and the Lincoln-Oseretsky motor tests yielded the very high multiple correlation of .80 with first grade achievement (Dudek et al., 1969a). In another paper Dudek reported that the best predictive combination for first grade achievement was the WISC Picture Arrangement and Information together with the Lincoln-Oseretsky motor tests and the Rutgers Drawing Test (R = .75)(Dudek et al., 1969b).

The Vane Kindergarten Test (Vane, 1968) is another attempt to predict achievement. This test has the merit that two of its three subtests can be given to groups, and that it is short.

The subtests are : Draw-a-man, copying of simple geometric forms, and a vocabulary test of 11 orally-presented words. Vane reported a correlation of .59 with first grade achievement (N = 94), while McKnab and Fine (1972) found that the highest correlation obtained with the Vane test was one of .49 between the Vane Vocabulary subtest and the Stanford Achievement Test Vocabulary subtest (N = 168). The correlations reported for the Vane test appear to be no better than the average correlations between the commonly administered readiness tests and reading.

The Sapir Scale (Sapir and Wilson,1967), the purpose of which is to identify kindergarten children likely to have learning problems, consists of 10 subtests which tap 3 factors (perceptual-motor, bodily schema, language). The perceptual-motor scale of 5 subtests appears to be able to predict reading better than the total scale (e.g. Stanford Paragraph Meaning : Total Sapir Scale, r = .65; Perceptual-motor Scale, r = .68; N = 54).

If one compares these special predictive test batteries with the group tests already reviewed, their disadvantage for widespread screening use lies in the length of some of them, and in the need for individual administration of many subtests. These shortcomings are not always compensated for by extremely high predictive validity. In fact, the majority of these special batteries do not predict achievement much better than some of the readiness tests. In the few instances where the correlations with later achievement were unusually high, further research appears to be warranted.

Single Variables versus Multifactor Tests

When reviewing the predictive validity of test batteries, it becomes apparent that single subtests are sometimes better predictors than the total battery to which they belong. Some examples follow.

Goins' (1958) Pattern Copying subtest, which formed part of her battery of 14 visual perceptual tests, correlated .519 with reading, compared with .497 for the entire battery. The predictive power of Pattern Copying was confirmed by Barrett (1965), who found this test second only to Gates' Reading Letters and Numbers as a predictor of reading.

A subtest which may have potential as a predictor is the ITPA Visual Motor Sequential (1961 edition; = Visual Sequential Memory, 1968 edition). Hirshoren (1969) found that this ITPA subtest correlated .61 with second grade reading, compared with .47 for the total ITPA. Correlations of visual memory with spelling and arithmetic were also higher than those of the total test. This finding requires further validation, however, as the sample size was small (N = 40).

Subtests of the Frostig DTVP have also sometimes proved to be more predictive than the total test: Spatial Relations (Mlodnosky, 1972), Position in Space (Colarusso, 1975).

The ability of the young child to write his first and last name and the numbers from 1 - 20, which is the Writing subtest from the Gesell School Readiness Tests (GSRT), was almost as predictive of reading as the battery of 5 GSRT subtests (Stanford Reading : Writing subtest, r = .60; GSRT, r = .63)

and superior to a battery of Piagetian tasks (r = .58) and to Lorge-Thorndike IQ or mental age (.48, .51) (Kaufman and Kaufman,1972).

A letter naming subtest is found in most reading readiness tests. Letter naming has long proved to be one of the best predictors of later reading achievement (Dykstra,1967). Studies which have included a letter naming subtest as a predictor are shown in Table 3. The range of correlations with reading is from .39 to .79 compared with .22 to .78 for total readiness tests. In nearly all the studies quoted in Table 3 letter naming was the best, or nearly the best, predictor of reading from among several subtests, and in nearly every instance it surpassed visual discrimination (matching of letters or words) in predictive power.

The Numbers subtest of the Metropolitan Readiness Test has also been found to be a superior predictor of later achievement, including reading (Giebink and Birch,1970; Hirst,1969; Kingston,1962; Rosen and Ohnmacht,1968; Serwer et al.,1972). In a predictive study involving 919 children the Numbers subtest correlated higher with all three aspects of reading measured than did the total MRT (Numbers x Mean Reading : r = .589; MRT x Mean Reading : r = .511) (Mitchell,1962).

A single variable test which has been used in many predictive studies is the Bender Visual Motor Gestalt Test. The range of 25 correlations quoted in 12 studies is .17 to .68, with a median value of .39. Correlations are with reading in

23 of the 25; the other 2 are with total achievement (Koppitz et al.,1961).(de Hirsch et al., 1966; Duffy et al., 1972; Egeland et al., 1970; Feshbach et al., 1974; Giebink and Birch, 1970; Henderson et al., 1969; Keogh and Smith, 1967; Keogh and Smith, 1970; Koppitz et al., 1959: Koppitz et al., 1961; Lessler and Bridges, 1973; Smith and Keogh, 1962). Views of the Bender's value as a predictor vary from that of Koppitz (1964), who concluded that it is as effective as a readiness test, to that of Giebink and Birch (1970), who caution against making predictive statements solely on the basis of the Bender.

Variables which may be implicated in the discrepant findings are method of administration (i.e. group vs. individual), age at criterion testing, sex and SES. Keogh and Smith (1967) found that the predictive power of the kindergarten Bender increased considerably between grades 3 and 6. However, in the studies quoted there is almost equal variability in the correlations for grade one as for the higher grades (G.4 - 6). Keogh and Smith (1970) found that at all grades (2 - 5) the kindergarten Bender predicted more accurately for boys than for girls. Norfleet (1973), however, reported that the Bender predicted poor reading more accurately for boys than for girls, but good reading more accurately for girls. It has also been pointed out that although the Bender is an effective predictor for children of lower SES, it is comparatively poor as a predictor for children of higher SES (Koppitz, 1964; Norfleet, 1973). Middle-class children of high verbal ability, and girls

in particular, are able to compensate for below average visual-motor ability.

In contrast to visual-motor copying tests such as the Bender, the predictive power of human figure drawing tests appears to be fairly uniformly low. The range of 6 correlations of figure drawings with reading or with total test achievement is from .23 to .46, with 4 of the 6 being less than .30 (de Hirsch et al., 1966; Dudek et al., 1969b; Koppitz et al., 1959; McKnab and Fine, 1972; Panther, 1967).

Teacher Judgement versus Formal Tests

A comparatively simple alternative to prediction of academic success or failure from test performance is prediction based on teachers' judgements. Several researchers have commented on the "remarkable" or "most surprising" accuracy of teacher prediction of academic success or failure (de Hirsch et al., 1966; Jansky and de Hirsch, 1972; Keogh and Smith, 1970). A survey of the predictive accuracy of 142 teachers' judgements for 3156 children (Kottmeyer, 1947) found that their mean rate of accuracy was 71.4 percent, and that years of teaching experience correlated positively with accuracy (5 years = 65.9%; 10 years = 75.7%). Kottmeyer reported that teachers were able to predict reading success about 5 percent better than the Metropolitan Readiness Test. More recently, however, no difference was found between experienced and beginning teachers in accuracy of judgement (Kapelis, 1975).

In one study (Keogh and Smith, 1970) the correlations between the March kindergarten Bender and grade 5 reading

were .37 for boys and .29 for girls, while the corresponding correlations for teachers' predictions were .69 and .61. The superiority of kindergarten teachers' judgements over the Bender was consistent for grades 2 - 5, for both sexes, and for arithmetic as well as for reading.

In another study (Serwer et al.,1972) teacher judgements on 10 behavioral traits were more consistently related to first grade achievement than any of the large battery of standard tests. Thackray (1965) found that teachers' ratings of general ability correlated moderately highly with reading (.506 & .524), while a check-list of a child's indoor and outdoor interests for teachers and parents to complete surpassed all other measures in predicting reading (r = .72) (Banham,1958). Kindergarten teachers' ratings of children on a questionnaire were found to predict first grade reading achievement at least as well as an extensive battery designed for that purpose (Peshbach et al., 1974). Teacher 5-point rating on Concentration surpassed all the tests in a large battery (Binet, Frostig, PPVT, Wepman) as a predictor of first grade reading (r = -.696((Benger,1968).Rating on Attention in kindergarten was significantly related to all six areas of achievement and to total achievement at grade 5 (Attwell et al.,1967). When end-of-year reports written by kindergarten teachers were correlated with later achievement (grades 2 - 6), it was found that the reports were very successful in predicting learning disabilities (Cowgill,1973).

A failing of teacher judgements appears to be a tendency to overestimate success and to underestimate failure (Annesley,1970).

Nevertheless, Kottmeyer (1947) concluded that a large city system with concern for budget would get fairly accurate predictive results by relying upon the judgements of experienced teachers, and more recent research appears to support this conclusion.

Preliminary Report on a Current Project to Predict Underachievement

Since the Massachusetts Special Education Act of 1972, Chapter 766, came into effect in September, 1974, it has been mandatory in Massachusetts to screen all children at or before kindergarten entry, and also to screen for high-risk 3- and 4-year-olds.

In Holbrook, Massachusetts, we have been evolving our own screening battery, checking on its short-term predictive validity, and attempting to improve it each year. We have, however, been working against the predictive validity of our screening measures: We have given in-depth evaluations to children identified as potentially high-risk and, when we deemed it necessary, have provided these children with tutoring, while in kindergarten.

According to the State law, kindergarten entry screening must include a comprehensive health assessment, assessment of vision and hearing, an assessment separately and in integration of the child's visual, auditory, and motor functioning, and assessment of the child's language functioning, including comprehension, expressive abilities, maturity of articulation, and grammatical and conceptual development. Information from parents through interviews, questionnaires etc. of early

developmental history etc. is also required.

The first group of approximately 200 children to be screened was given a battery of tests soon after kindergarten entry. The battery included visual-motor tests (Name Writing, Gesell Copy Forms, Draw-a-Person), language tests (ITPA Auditory Association, Spencer Memory for Sentences, Informal Language Sample), gross motor tests (modified Purdue Perceptual-Motor Survey), and tests of readiness or pre-academic skills. To test pre-academic skills the teachers used a questionnaire we developed, which included letter knowledge, counting, color naming, ability to name shapes etc. Each child was also rated on pencil grasp, coloring and cutting ability, attention span, and ability to complete assignments on this questionnaire. On a separate section of the questionnaire the teachers also rated each child on self-help skills, interpersonal relationships, and language in the classroom.

Validation was carried out by correlating the screening with the end-of-year Metropolitan Readiness Test. For boys the Pearson Product Moment correlation between the screening total and the MRT was .767, while for girls it was .684.

The next year group of approximately 200 children was screened in March, 1975, 6 months before kindergarten entry. The mean age of the group was 4 years 9 months.The screening battery had been refined to consist of a social skills questionnaire and developmental history, both filled out by parents, and the following individual test battery, which took about half-an-hour for each child: Visual-motor tests (Name

Writing, Gesell Copy Forms, Draw-a-Person, pencil grasp, cutting with scissors), language tests (WPPSI Information and Memory for Sentences, ITPA Auditory Association, Gesell Prepositions, Informal Language Sample), gross motor tests (McCarthy Scales Leg Coordination subtest), and pre-academic skills (naming 13 letters, 8 colors and 5 shapes; counting). Each child received a total screening score, as well as scores for visual-motor ability, language etc. The following February, which was nearly 11 months later, a random sample of 45 children in the group was administered the Peabody Individual Achievement Test (PIAT), and Pearson Product Moment correlations were computed between the screening measures and the PIAT.

The correlation between the total screening test and the total PIAT, which includes Mathematics, Reading Recognition, Spelling and General Information subtests at the kindergarten level, was .86. The 5 measures which were by far the best predictors of all aspects of achievement were the WPPSI Information, WPPSI Memory for Sentences, Name Writing, Naming Letters, and Naming Shapes. The best predictor of beginning reading skills was not Letter Naming (r = .676), but Naming Shapes (r = .695). Naming Letters was the best predictor of Spelling (.754) surpassing the total screening battery (.708). Whereas naming the 5 Gesell shape (circle, square, triangle, cross, diamond) was a strong predictor, copying the same shapes was one of the poorer predictors in the battery.

Both the year groups screened so far will be followed up, and the predictive validity of the screening measures will continue to be evaluated, as the children have their annual

standardized achievement tests.

Another predictive project under way in Holbrook concerns the year group of children who are now in second grade and who predated the Massachusetts State screening law. This group of 200 children was administered the MRT and the Beery Visual Motor Integration Test toward the end of kindergarten. At the beginning of first grade they were given a short 10-15 minute group screening test (Verbal Auditory-Visual Integration, adapted from Badian, 1974). The premises underlying this test are that it is auditory memory and sequencing skills that are particularly important in the learning of reading, and that it is not necessary for a screening test to be long.

In this test the examiner reads a sequence of the names of geometric forms , varying in length from 3 to 5 words (the names used are circle, square, triangle, cross). The children then draw a mark in a booklet on the one of 3 visual sequences of forms, which exactly corresponds to what the examiner has just said. There are 4 practice items and 10 test items.

An earlier pilot study elsewhere showed that this short test was a better predictor of end-of-first-grade reading comprehension (Gates-MacGinitie) than the total Clymer-Barrett Prereading Battery. For the 103 boys in the Holbrook study the Verbal Auditory-Visual Integration Test was a better predictor of the end-of-first-grade Stanford Achievement Test Word Meaning, Paragraph Meaning, Spelling and Word Study Skills than the total MRT. For the 82 girls, correlations were less high than for the MRT. The long-term predictive validity of the test will continue to be investigated.

Conclusions

After reviewing predictive studies of the past 40 years, one is left with the impression that prediction of school achievement is little more accurate today than it was when Lee in 1934 and Monroe in 1935 created their test batteries. The predictive validity of the majority of measures is no more than moderate (with correlation coefficients falling mainly between .40 and .60), and the variability in predictive power of the same test from one sample to another does not inspire confidence.(See Table 4.) Furthermore, there is no guarantee that the child with potential learning problems will be identified through his performance on a predictive test, even when the predictive variable demonstrates a high correlation with later achievement. Prediction of the high achiever appears to be more certain (Muehl and Kremenak,1966; Powell and Parsley,1961). Even Jansky and de Hirsch's Final Screening Index, which was the result of many years of research, failed to identify 20 percent of children with learning problems (Jansky and de Hirsch,1972). To obtain greater refinement in accuracy of prediction, it is probably necessary to give more weight to such variables as sex and SES . Teaching methods (Stauffer and Hammond,1965; Tanyzer and Alpert,1965) and teacher competence (Jansky and de Hirsch, 1972) are variables which affect predictive power, but which it is not possible to control.

In general, for overall predictive accuracy group-administered test batteries appear to be somewhat superior to individually-administered batteries, with readiness tests

surpassing other types of group tests. Not infrequently, however, single subtests within a battery appear to be satisfactory substitutes for the total battery, and there is compelling evidence that kindergarten teachers' forecasts are more accurate predictors than many, if not most, formal tests. This may be because, in making their judgements, teachers intuitively include many of the behavioral variables that are only indirectly measured in formal tests. The reason that group tests generally tend to be better predictors than individual tests may be that they more nearly approximate the behaviors involved in the usual school tasks. The reason why letter naming and number subtests are among the best predictors of later school achievement may be that they are examples of early academic learning. The child has, in fact, already demonstrated that he is able to absorb academic learning.

It may be difficult to identify children with potential learning problems because, as some authors have pointed out, among kindergarten children there are very few consistent and identifiable patterns of characteristics associated with future learning problems. Certainly, from the point of view of administrative expediency, as well as from that of predictive accuracy, kindergarten teacher judgements, perhaps based on a behavioral checklist, together with a simple test of ability to name letters and shapes, would seem to contribute as much or even more toward the identification of children likely to underachieve, as the test batteries specially designed for such identification.

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Table 1a

Predictive Validity of Metropolitan Readiness Test

Correlations with Reading**

Study	No. of Ss.	Correlation
Bremer (1959)	2069	.40
Bryan (1964)	25	.25
Dean (1939)	116	.59
Fry (1965)	393	.62
Giebink & Birch (1970)	93	.22
Hayes & Nemeth (1965)	363	.64
Karlin (1957)	111	.36
Koppitz et al.(1961)	73	.59 (Ach.)
Kottmeyer (1947)	3115	.46
Lessler & Bridges (1973)	293	.76
Mitchell (1962)	919 (white)	.58
	251 (black)	.58
Scott (1970)	151	.53
Sheldon & Lashinger (1966)	467	.70
Stauffer & Hammond (1965)	201*	.47
	232*	.78
Tanyzer & Alpert (1965)	220*	.52
	220*	.57
	220*	.62
Wilson & Burke (1937)	25	.47
Wright (1936)	208	.44

Ach. : r with total MAT achievement.
* Different reading methods.
** In all tables correlations with reading comprehension subtests are given, whenever possible.

Table 1b

Predictive Validity of Lee-Clark Reading Readiness Test

Correlations with Reading

Study	No. of Ss.	Correlation
Hayes & Nemeth (1965)	363	.55
Henig (1949)	98	.55
Hopkins & Sitkei (1969)	157	.61*
		.57**
Koppitz et al. (1961)	199	.66 (Ach.)
Lee et al. (1934)	92	.68
	100	.54
	164	.49
Lessler & Bridges (1973)	293	.74
Panther (1967)	44	.66
Powell & Paraley (1961)	703	.43

Ach. : r with total MAT achievement.
* r with Lee-Clark Primary.
** r with Teachers' marks.

Table 2

Predictive Validity of Group Intelligence Tests

Correlations with Reading

Study	No. of Ss.	Intell.Test	Correlation
Beck & Beck (1960)	214	CTMM	.48
Bryan (1964)	25	K-A	.32
Dudek et al.(1969b)	91 (G.1)	L-T	.42
	74 (G.2)	L-T	.57
Dykstra (1966)	632	L-T	.42
Feshbach et al. (1974)	433	Otis	.45*
			.50**
Gates (1940)	7 classes	P-C	.45
Gavel (1958)	1506	Otis	.45
Giebink & Birch (1970)	93	K-F	.48
Kaufman & Kaufman(1972)	80	L-T	.48
Kottmeyer (1947)	3115	Detroit	.42
Lee et al. (1934)	100	P-C	.39
	164	Detroit	.41
Lessler & Bridges (1973)	293	CTMM	.73
Monroe (1935)	85	Detroit	.57
Morphett & Washburne (1931)	141	Detroit	.50
Muehl & Kremenak (1966)	108	L-T	.10
Olson (1958)	1172	Otis	.41
Panther (1967)	44	L-T	.47
Pratt (1949)	72(K exper.)	Detroit	.39
	128(No K exper.)	Detroit	.57

* Coop. Primary Reading Test; ** Gates-MacGinitie Reading Test.
CTMM = California Test of Mental Maturity; K-A = Kuhlmann-Anderson;
L-T = Lorge-Thorndike; P-C = Pintner-Cunningham; K-F = Kuhlmann-Finch.

Table 3

Predictive Validity of Letter Naming Tests

Correlations with Reading

Study	No. of Ss.	Correlation
Bond & Dykstra (1967)	9104	.52 - .60
de Hirsch et al. (1966)	53	.55
Egeland et al. (1970)	82 (boys)	.39
Gates (1940)	5 classes	.39 - .66
	14 classes	.45
Gavel (1958)	1506	.58 (capitals
		.54(lower cas
Jansky & de Hirsch (1972)	347	.54
Lowell (1971)	161	.63
Muehl & Kremenak (1966)	108	.57
Olson (1958)	1172	.55(capitals)
		.53(lower cas
Silvaroli (1965)	87	.55(boys)
		.72(girls)
Weiner & Feldmann (1963)	126	.72(capitals)
		.70(lower cas
Wilson & Burke (1937)	25	.79

Table 4

Correlations with Achievement

Predictive Test	No. of Correlations	Range	Median
MRT	37	.22 - .78	.58
Lee-Clark	11	.43 - .74	.57
Clymer-Barrett	5	.40 - .69	.61
Group IQ Tests	22	.10 - .73	.45
Frostig DTVP	8	.06 - .62	.425
WISC and WPPSI	11	.20 - .57	.39
Stanford-Binet	5	.31 - .62	.53
PPVT	4	.16 - .62	.345
ITPA	7	.13 - .43	.32
MSSST	4	.53 - .82	.64
Letter Naming	19	.39 - .79	.55
Bender	25	.17 - .68	.39
Figure Drawings	6	.23 - .46	.28

MRT = Metropolitan Readiness Test
PPVT = Peabody Picture Vocabulary Test
ITPA = Illinois Test of Psycholinguistic Abilities
MSSST = Meeting Street School Screening Test